

Composite Attachment Nail

One missing piece of technology needed for the DD(X) is a robust, easy-to-install method for attaching the myriad of outfitting items required in a ship fabricated using fiber reinforced composite materials. While there are a variety of methods for introducing loads into a composite sandwich panel, most require some form of local solid laminate reinforcement or buildup that must be pre-located in the structure. The Materials Sciences Corporation (MSC) developed hollow-can composite attachment nail (MSC-CAN) overcomes current technology shortfalls by providing an easy to install structurally robust method for mounting light to heavy weight equipment in large composite ship sandwich structures.

Current techniques for outfitting a composite structure with equipment includes bonding pads to the facesheet for lightweight items, the use of pads attached with self-tapping screws for medium weight equipment, and through-bolting once the load limit of the screws is reached. Each of these methods has drawbacks. Bonding is limited in the maximum loads that can be carried, particularly under shock conditions. The major drawback of screws is that the load capability is not easily scaleable, i.e., if the load exceeds the capability of a single screw, using multiple screws in a limited space may not significantly increase the attachment load capability. Additional load carrying capability requires a through-bolt attachment that must be sealed (and maintained) to prevent moisture intrusion and can have an adverse effect on stealth or hydrodynamic performance.

MSC has developed a composite attachment insert that is a lower cost, higher performing alternative to traditional metallic fasteners for attachment of equipment to composite sandwich structures. The MSC hollow-can composite attachment nail (MSC-CAN) has the following key features:

- The composite attachment nail is not a through-penetration, therefore, the sandwich panel remains sealed preserving stealth and water-tightness, and all installation work can be accomplished from one side.
- The composite attachment nail insert concept is scaleable for a range of load requirements. Load capacity depends on the sandwich core thickness and material.
- Testing has shown that ultimate failure of the attachment nail does not damage the sandwich panel instead of pulling off an entire facesheet.
- Standard inexpensive room-temperature cure adhesives can easily develop the full shear strength of most any core material.
- The glass-fiber reinforced composite attachment nail provides a chemically inert non-corrosive barrier between metallic fasteners (e.g., steel bolts) and graphite fiber composite facesheets.
- The core material provides heat insulation, which improves the fire performance of the attachment concept.

Testing showed that a single MSC-CAN developed the same strength as the 4-screw mounting pad. Unlike the legacy screw approach, overloading the attachment has little effect on the basic composite sandwich structure. The technology is also scalable to equipment mounting requirements; i.e., a larger or smaller MSC-CAN is available depending on load capacity required

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Photograph of the first generation non-corrosive MSC-CAN alone and potted in a composite sandwich.

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